audio file

test itself

- 170 questions in 2 hours
- only 10 questions on each system – 17 systems total
- majority of people tend to finish – 1:15 to 1:40 mark
- some questions are memory items and limitations – chapter 2 of SOPM
- when it comes to weight, you'll only see the 76 weight numbers
- 10 memory items – QRC
- 80% or above
- submit or defer the question
- paper retakes – if you score below 80% in any system, it has to be corrected to 100%
- can bring cockpit poster to the test – every synoptic page on the bottom
    - systems – status
    - systems – fuel
    - systems – hydraulics
    - systems – ECS
    - systems – flight controls
    - systems – electrics

starts in the flight deck – overhead panel

DVDR panel

- DVDR panel (digital voice and data recorder)
- part of CA's originating flow
- push test button – look at EICAS – make sure no messages

electrical panel

- we have both DC and AC sources of power
    - DC sources of power – 2 BATT and a DC power card
    - AC sources of power – 2 IDGs (integrated drive generators), APU, AC ground power, RAT

- convert AC power to DC power – TRU (transformer rectifier units)
    - we have 3 TRUs – TRU 1, TRU 2, TRU ESS
    - TRU ESS important for electrical emergency
    - converts AC power from primary AC sources of power to keep the DC system going

- convert DC power to AC power – inverter
    - we have 1 for the AC STDBY BUS
    - AC STDBY BUS
        - has igniters – that's why the inverter is important – runs from DC system up to AC STDBY BUS and gives us igniters

- leave knobs in AUTO, unless QRH directs otherwise
    - purpose of AUTO – airplane turns on/off sources of power, automatically opening/closing bus times to make sure much of the airplane is powered in accordance with the power priority – onside, inside, outside, cross-side
    - 2 AC BUSES say – do I have onside power? – that sides IDG. if yes, then it takes it. if not, then it looks for inside power – APU. if it doesn't have that, then it looks for outside power, AC GPU. if not, then if finally looks across on the other side to see if it has another IDG
    - knobs in AUTO – BUS TIES open/close automatically to make sure the airplane is powered as much as possible based on what sources are available
    - this is what AUTO means

- BATT 1 – OFF and ON, BATT 2 – OFF and AUTO – what's the difference?
  - why does BATT 2 have an AUTO position? – it has to do with APU start
  - I need to power the APU FADEC and APU START BUS
  - during an APU start
    - BATT 1 in charge of APU FADEC
    - BATT 2 energizes the APU START BUS
    - which one can I replace? – I can replace BATT 2 going to the APU START BUS, but BATT 1 is required
    - in other words – AUTO means BATT 2 can give control of the APU START BUS to a DC power card
    - if I plug in a DC power card, BATT 1 runs the FADEC and BATT 2 doesn't do anything and the DC power card runs the APU START BUS until the APU is running
    - this explains the difference between OFF/ON and OFF/AUTO for BATT 1 and BATT 2

- running Safety and Powerup Checklist
  - turn BATT 1 to ON; BATT 2 to AUTO – airplane starts powering up
  - now I'm looking for 3 things
    - screens 2 (MFD) and 3 (EICAS) showing me a status page (MFD) and an EICAS
    - looking at battery voltage – I need to see at least 22.5V on both batteries
      - if its between 21.0 and 22.5 – open up SOPM and run the battery recharging procedure
        - SOPM asks for battery temperature
        - can I see battery temperature on DC only? no – battery temperature is on the electrical synoptic page
        - on DC power only, only synoptic page I have access to is status
        - only way to get battery temperature is from AC power
        - I finish my Safety and Powerup checklist – then I have AC power
      - if below 21.0 on either battery – call MX (don't have enough power to do what I need to do)
      - why 22.5V? – 22.5V guarantees me my 10 minutes of battery life and 2 APU starts (if I go down to DC only in flight – if I have an electrical emergency in flight)
    - IESS – should be ON and aligning (90 seconds to align)
      - I don't want the airplane to be moved while aligning

  - GPU (ground power unit)
    - APU GEN stays dark – as APU starts, it will automatically provide power in accordance with that power priority

  - IDG (integrated drive generators)
    - 3 switch positions – AUTO, OFF, DISCONNECT
      - AUTO – as engine starts and IDGs start to provide power, they will provide power in accordance with power priority
      - OFF – turning off IDG
      - DISCONNECT – mechanically severing the IDG from the engine and I can't get it back
        - usually do this when amber light displays means 1 of 2 things:
          - high oil temperature or low oil pressure – HOTLOP
        - during PT, QRH will direct you to disconnect an IDG
          - high oil temperature – concerned about having a fire
          - low oil pressure – concerned about IDG causing damage to engine
          - point is – I'd rather disconnect a bad IDG, than have engine damage (rather lose an AC power source than lose an engine)

- 3 things happen when I get AC power connected to the airplane
  - windshield heat runs its 2 minute / 120 second test and then both power off – stay off until I have 2 sources of power on the ground
  - IRSs begin aligning
    - can take up to 17 minutes for IRSs to align
    - can be re-aligned in flight, but have to feed them a new initial position from one of the GPS receivers
  - E P-BIT (electrical powerup built in test)
    - FLT CTRL TEST IN PROG – airplane testing flight control components of flight control system (FCMs and ACEs)
    - checking for outer tolerance conditions – surfaces aren't moving, but airplane is sending a bunch of electronic signals through the computer portion of the FBW system
    - test runs for 3 minutes
    - 3 ways to interrupt it
      - interruption of AC power
      - pressing a flight control mode switch – pressing a flight control mode switch (normal to direct mode) takes FCM out of the loop
      - if any hydraulic system is pressurized

  - let's talk about H P-BIT (hydraulic powerup built-in test) since we're on the topic
    - H P-BIT runs once I've started an engine and all 3 hydraulic systems are pressurized OR
    - if I pressurize the system myself in the order of 3,1,2
    - this tests the hydraulic components of the flight control systems – the actuators
    - there isn't any flight control movement
    - test with really tight tolerances
    - test if for 1 minute
    - FLT CTRL TEST IN PROG – shown on EICAS
    - how to interrupt the test? – move a flight control surface

- electrical emergency
  - loss of normal AC power to AC BUSES 1 and 2
  - each AC BUS asks – onside, inside, outside, cross-side – independently of each other
  - example
    - 35,000', lightning strike kills both IDGs
    - engines are still running
    - if APU is on, are we in an electrical emergency? no – I still have a normal AC power source
    - but if APU isn't running, I don't have AC power (both IDGs aren't working + APU OFF)
    - I lose both IDGs – I go into electrical emergency
    - now I have the same thing I had when doing the Safety and Powerup checklist
      - dome lights, light in standby compass, screens 2 and 3 (but get PFD and EICAS – not status and EICAS), IESS, clock, com panels (with interphone), DC fuel pump, main injector pumps running to (still have engine running), AC STDBY BUS makes sure I have igniters....
      - on batteries only...left side – com 1, nav 1, IRS 1, CCD 1 (left side flying and talking)
      - on batteries only...right side – GPS 2, FMS 2, MCDU 2 (right side building – Embraer thinks of it this way)
    - I can be in this configuration for 10 minutes – that's the purpose 22.5V
    - emergency lights in back of airplane on (because we leave those in ARMED)
    - first 8 seconds of going into electrical emergency – RAT should automatically deploy
      - how do I know its deployed? 2 EICAS messages (electrical emergency and battery discharging)
      - BATT DISCHAGE means RAT has not deployed or not started supplying power
      - when BATT DISCHARGE goes away – RAT is out and charging
      - RAT stops the battery from discharging
      - RAT comes out and latches on to the AC ESS BUS (remember AC STDBY BUS comes from inverter; AC ESS BUS powered by the RAT)
      - 4 things I get back on that AC ESS BUS (3-2-2-1)
        - HYD PUMP 3A

        - why HYD PUMP 3A? – 1 actuator for each primary flight control surface
    - ACFP 2
        - why 2 instead of 1? – ACFP 2 can help me with ENG 2 if I needed that and APU start
    - slat channel 2
        - help me slow down, configure, and land
    - flap channel 1
        - help me slow down, configure, and land

- RAT – 150 kts to spin it up; 130 kts minimum operating speed
- if I get my APU running or one of my IDGs back – I'm no longer in electrical emergency
    - why? I have a normal source of AC power back to AC BUS 1 and 2 (remember any single AC source can power the entire airplane)

- HOT BATT BUS
    - no power at all (batteries OFF) – I still get my pressure refueling panel (airplane can be refueled with no power) and engine fire fighting
    - example
        - airplane is cold and dark (batteries OFF) – cold day outside, MX has heater on blowing hot air into the engine, starts a fire in the engine. I'm in the flight deck (cold and dark), batteries OFF, nothing is lit up (overhead panel) because I don't have detection, but I do have protection, so I pull the fire handle (HOT BATT BUS)
            - shuts off bleed fuel hydraulic
            - arm the fire bottle
            - then I twist the fire handle to discharge 1 or both fire bottles into that engine even without any power

- display reversion
    - 3 rules that tell you how the airplane reverts displays if something fails
        - airplane doesn't care about the MFD (screens 2 and 4 go dark) – airplane doesn't care
        - airplane wants me to have a PFD and EICAS – why? because of control and performance instruments
        - PFD generally defaults to the left side for the CP

cockpit lights panel

- MAIN PANEL, OVHD PNL, PEDESTAL, DOME, ANNUNCIATOR TEST
- annunciator test – pushed by CP on Originating Flow – looking for any burned out bulbs

fire protection panel

- where do I have fire protection on the airplane?
  - engines, CRG (FWD/AFT), APU, and lavatories

- engine fire protection
  - each engine has 2 fire detection loops – these generate the light in the fire handle and give me the engine fire indication
  - if the fire light goes out, its not a guarantee the fire went out (fire could be really bad and burned through my detectors loops and my sensing system)
  - when I pull the fire engine handle, 4 big things close:
    - close fuel SOV
    - close hydraulic SOV
    - close engine bleed valve
    - close crossbleed valve
      - yes – I can open those valves again by putting the fire handle back
  - by pulling the fire handle, the fire bottles are ARMED
    - 2 engine fire bottles – they are the same
    - I can discharge 1 or both into a single engine OR 1 into the left engine and 1 into the right engine

- APU fire protection
  - 2 fire detection loops
  - has its own dedicated fire bottle
  - airplane will never fire a fire bottle without us first taking action from the flight deck with the exception of the lavatory
  - we can't control that one from the flight deck – know that it exists – that's it

  - APU has FADEC just like the engines
    - APU FADEC monitoring / running APU start and shutdown
    - APU FADEC can make emergency shutdowns of the APU if certain conditions are met
  - if I do an emergency shutdown of the APU, either by pressing the APU EMER STOP shutdown button (guarded) or if the APU FADEC does it automatically, it does so by closing the APU fuel valve – starves APU of fuel – that's how an emergency shutdown of this APU is done

- when will the APU FADEC command an emergency shutdown of the APU?
  - in flight (3)
    - UFO – underspeed, FADEC critical fault, overspeed
      - under or overspeed, I'm worried about structural damage to the APU
      - FADEC critical fault – will command an emergency shutdown
  - on the ground (8)
    - UFO SHELF
      - underspeed, FADEC critical fault, overspeed, sensor failure, high oil temperature, EGT over-temperature, low oil pressure, fire
      - only time APU will shut down for a fire is when? on the ground, not in flight

      - if I get an APU fire on the ground, FADEC will detect it
        - after 10 seconds of detecting the APU fire, it will shut down the APU
        - can I make this happen on my own? yes I can
        - I can press and hold the fire test button for 10 seconds – APU will emergency shut down
        - airplane doesn't know the difference between the test button and a real fire – APU running and I press and hold the fire test button, it will shut down the APU (don't do that by the way)

      - if it shuts down, I will see a red stripe light in the EMER STOP guarded button
      - if directed by the QRH to push the switch, the white stripe light will come on

    - if there's an APU fire – the APU EMER STOP guarded button will show a red stripe light
    - if there's an APU fire for more than 60 seconds – white stripe light will show

        - 10 seconds is the shutdown of the APU because of a fire...after 60 seconds, the white stripe light will automatically turn on

- CRG (FWD and AFT)
    - 2 fire bottles – they are not the same
        - I have a hi-rate and low-rate bottle
        - purpose of hi-rate is to discharge first to put out / suppress the fire
        - purpose of the low-rate bottle is to discharge afterwards at a lower rate for 75 minutes
            - why 75 minutes? allows me 60 minutes of in-flight time to divert and 15 minutes on the ground
        - both bottles can be armed either to the forward or aft

    - 2 cargo compartments are also not the same
        - both are pressurized, but 1 is ventilated and 1 is not ventilated
        - FWD CRG is ventilated (air circulation system)
            - live animals goes here (conditioned normal air circulating for them)
            - dry ice goes here (circulating the CO_2 out)
                - can't have live animals and dry ice together at the same time
        - AFT CRG is not ventilated

    - 3 rules that will describe every situation to you
        - at a minimum, I need to press the fire CRG button once to discharge a fire bottle
        - add a press for non-annunciated – if it is a non-annunciated fire, I need to add a press (press again)
            - what is a non-annunciated fire?
                - annunciated means the smoke detectors and the cargo compartments detected something and I get a CRG FWD or CRG AFT smoke message on EICAS – airplane detects that – once detected, it will arm the cargo bottles to the appropriate cargo compartment – if it's the aft, it will just arm the hi and low-rate bottles to go to the aft. if it's the FWD, it arms the hi / low rate to go to the forward and isolates the smoke from the rest of the air system – in other words – ventilation outflow valve closes and air circulation fan turns off – completely isolated. this is all done automatically if the airplane detects smoke/fire itself
                - non-annunciated – no indication from EICAS or the overhead panel
                    - I press the FWD or AFT button – this ARMS the system
                    - first press arms the system; second press discharges the bottle
        - add a press for the low-rate bottle on the ground
            - why? – if I'm in flight, and I discharge the hi-rate bottle. after 60 seconds, the low-rate bottle discharges. why? because I'm in flight. I want it to continue suppressing that fire and give me time to get on the ground
            - but if I'm already on the ground, and I potentially have access to emergency equipment and I'll probably be evacuating the airplane, I don't want to start 75 minutes of Halon discharging
            - if I want the low-rate bottle on the ground, I have to press the button again

- fire test
    - safety and powerup checklist
    - when am I required to do this?
        - any time it is my FFOD in that particular airplane – anytime I have not flown that particular airplane
        - if I switch to another airplane that I haven't flown that day, I have to do the fire test
    - 6-5-2-2-2
        - 6 lights on overhead panel
            - fire handle 1, fire handle 2, FWD CRG smoke, AFT CRG smoke, APU smoke, APU EMER STOP
        - 5 EICAS messages
            - ENG fire 1, ENG fire 2, FWD CRG smoke, AFT CRG smoke, APU fire
        - 2 fire indications on ITT (EICAS)
        - 2 master warnings flashing – one of left; one on right
        - 2 aural alerts
            - triple chime associated with the master warning
            - fire bell associated with the fire

fuel

- 2 fuel tanks on airplane
  - each fuel tank divided into 3 sections – collector tank, main tank, surge tank
  - main tank – holds the fuel
  - collector tank – keeping the main ejector and ACFP submerged – these two pumps run fuel to an engine
    - this tank actually feeds the engine
  - surge tank – empty void space out on the wingtip edge of the wing – fuel has a place to go during expansion, over pressure, or high altitude maneuvering
    - its a spill-over area in the full tank that will then go back into the main fuel tank
- primary pump that feeds fuel from the collector to the engine
  - main ejector pump
    - venturi pump – a motive flow pump – no moving parts – its suction driven – self-sustaining pump w/ no moving parts
      - pressure comes from a return line on the engine driven fuel pump
    - if the main ejector pump fails, there is a backup – AC fuel pump
    - transporting fuel from the main fuel tank to the collector – majority of this process is handled by gravity
      - in addition to gravity – there are 3 scavenge ejectors (also motive flow pumps) – makes sure fuel gets from main fuel tank into the collector tank (to keep that collector tank full)
  - how many fuel pumps on the left wing? 5
    - 3 scavenge ejectors, AC pump, main ejector
  - how many fuel pumps on the right wing? 6
    - 3 scavenge ejectors, AC pump, main ejector, DC fuel pump
      - DC fuel pump is in the right collector tank
      - DC fuel pump is a backup starter pump
      - DC fuel pump in AUTO
        - provides an initial source of fuel for ENG 2 start if AC power is unavailable
        - provides an initial source of fuel for APU start if AC power is unavailable
      - can't provide sufficient fuel to keep an engine running – can't keep up demand for a running engine too
        - it can provide a source of fuel for ENG 2 start
    - anytime AC power is available, the airplane will prefer AC fuel pump over the DC fuel pump because AC fuel pump is a bigger stronger pump

  - AC fuel pump
    - OFF, ON, AUTO
    - 3 times AC fuel pumps will turn on with a 4th condition for only ACFP 2
      - if main ejector fails, then AC fuel pump in AUTO will automatically turn on to keep the engine supplied with fuel
      - during engine start (assuming AC power is available), fuel pumps will turn on
        - ACFP 1 will turn on during ENG1 start as an initial source of fuel until the EDP (engine driven pump) runs fast enough to make the main ejector becomes self-sustaining
        - ACFP 2 will turn on during ENG2 start – same things as ACFP 1
      - cross-feed (XFEED)
        - way to balance fuel
        - can't takeoff or land with XFEED open
        - I'm burning fuel in order to balance it
        - if I select low 1 – XFEED valve opens, which connects the 2 sides of the fuel system
        - feeding both engines off of the same tank of fuel
        - when I choose low 1 or low 2, I'm telling the airplane which tank has less fuel – so I command the XFEED valve to open, and I turn ON (not AUTO) ACFP 2 (higher pressure on right side) – this will push the fuel over to the left side – I will be feeding both engines off of the high side
        - there is no AUTO mode for XFEED – if I had a fuel leak on the left wing, I don't want fuel being pumped to that tank in AUTO mode
        - limitation for fuel imbalance – 794 lbs
          - fuel and imbalance message will turn on at 800 lbs
          - can I takeoff with a fuel imbalance message? yes, as long as the difference is lower than 794 lbs
          - what makes the fuel imbalance message go away? when there is less than a 100 lbs difference

between the two tanks
        - is it possible to get a FUEL LO LEVEL EICAS message even though the EICAS gives green fuel indication? yes – tells me a possibility one of my scavenger pumps has failed
            - in other words, I've lost the ability to keep the collector full from the main fuel tank

    - 4th condition only for ACFP 2 – APU start
        - if AC power is available and I'm starting the APU, ACFP 2 will also turn on during APU start

- minimum fuel
    - 2250 lbs
    - 45 minutes
    - 1500' clean configuration, green dot
- emergency fuel
    - 1500 lbs
    - 30 minutes
    - 1500' clean configuration, green dot

- when does an individual tank turn amber? – 1320 lbs
- when does the total indication turn amber? – 2640 lbs

passenger signs

- emergency lights – ARMED – normal position – 12 o'clock position
- CP's Originating flow

- ATTND CALL – push this prior to lowering the landing gear

- STERILE – turned on by the CP
    - turned ON until 10,000' then turned OFF
    - turned ON descending through 18,000'

- FSTN BELTS
    - turned OFF after 10,000' and smooth air

- NO ELEC DEVICES

APU

- how to turn it on? go from OFF to ON – wait for dashes to turn into numbers – then START and back to ON
- turning APU OFF
  - goes into 1 minute cooldown period
  - closes APU bleed valve but continues providing APU power
  - if I want to turn it back on during that 1 minute cooldown period, I can turn it back on like nothing ever happened – it never spooled down
  - if it does spool down, I have to wait for it to completely shut down and turn it OFF before I restart it
  - at the end of the day, powering down the APU – I need to see the words APU OFF on EICAS and wait an additional 80 seconds OR I need to see the APU fuel valve close message on EICAS
    - the issue is – if FADEC is depowered prior to the APU fuel valve being closed, then the next time I turn the airplane on, FADEC gets confused and doesn't remember the APU fuel valve being open now its closed – disagree – APU failure

- APU can be used as a source of electrical power and bleed air
  - bleed air – pressurization up to 15,000', engine start up to 21,000'
  - APU starting altitude is 30,000'
  - maximum altitude for APU operation is 33,000'
  - can never use APU bleed air for anti-ice

windshield wipers

- 4 settings – OFF, LOW, HI, TIMER
- timer – 8 second delay
- speed limitation – 250 kts (SW)
- torque limiting system – turn wipers on with a dry windshield (can get stuck)

external lights

- FO mostly handles the external lights per checklists
- climbing through 10,000' FO will turn off everything but the top row (NAV, STROBE, RED BCN)
  - you can leave these lights on through 18,000' in areas of high traffic – provision in SOPM
- lights turn back on descending through 18,000'
- NAV LIGHT
  - indication to people outside the airplane we have AC power onboard the airplane
- RED BCN
  - turned on prior to engine start – indicates we are about to start an engine or already have an engine running
- INSP
  - see ice accretion on the wings

hydraulics

- ENG PUMP SHUTOFF (guarded)
  - deceptively named switch
  - they don't shut off the engine driven hydraulic pumps – they close the hydraulic SOV (isolates hydraulic pump from the rest of the system)

- 3 hydraulic systems
  - 2 larger ones are 1 and 2 (they are run driven by their engine driven hydraulic pumps)
  - 3 is the smallest – 1 actuator for each primary flight controls system

  - HDY SYS 3A (smallest one) – hydraulic electric pump A
    - no AUTO knob – why? because off of the RAT, I don't want any automation standing between the pump getting power and the pump turning ON
    - what do I do to stop the electric pump 3A from overloading the RAT? – 2 additional features on 3A that aren't on the other pumps
      - pump unloader valve
        - decreases the output of 3A when starting off of the RAT so it doesn't overload when its re-pressurizing system 3
      - flow limiter
        - reduces the overall output of system 3 on the RAT so that I can't overload the RAT by making demands on the hydraulic system

  - (SYS 3) electric hydraulic pump 3B – backup pump to 3A
    - does have AUTO – if 3A fails in flight, 3B will automatically turn on (on the ground it will not)
      - when I land, 3B will actually turn OFF – why? because it is the backup pump
      - do I need primary flight controls while I'm on the ground? no I don't

  - (SYS 1 and 2) hydraulic electric pumps 1 and 2
    - primary pump is the EDP (engine driven pump)
    - backups are the ACMPs (AC motor pumps)
    - ACMPs we typically leave in AUTO – turn ON in 3 conditions (4th condition that applies only to SYS 2):
      - EDP failure
      - takeoff – critical phase of flight
        - if I lose an engine I want the backup pump already running so there's no interruption to hydraulic pressure
        - (thrust reverers, brakes, spoiler panels, nosewheel steering) – I don't want to lose these in critical phases of flight
        - how does the airplane know it's taking off?
          - flaps > 0
          - 50 kts wheel speed OR
          - thrust levers in TO/GA
      - landing – critical phase of flight
        - how does the airplane know it's landing?
          - flaps > 0 (that's it – don't get it confused with something else)
      - 4th condition only applies to ACMP 2
        - anytime I have released the parking brake and started ENG 1, ACMP 2 will automatically turn on – it will stay running until I have set the parking brake and sat for 6 minutes with parking brake on
        - why? – airplane knows nosewheel steering is on SYS 2. if I release the parking brake and start ENG 1 – automatically turns on ACMP 2 to make sure I have nosewheel steering

- PTU (power transfer unit)
  - purpose – assist with landing gear extension or retraction if I lose engine driven pump 2 (EDP 2)
  - why do I need a PTU?
    - comes down to the flow rates between the EDP and the AC pumps
    - EDP provides 4 times the rate of flow compared to the AC pump

        - they both can provide about the same kind of pressure ~ 3000 PSI
        - difference is not the pressure but the amount of fluid being pushed through the system at that pressure
            - EDP gives about 20 gallons/minute of flow
            - AC pump gives about 4 gallons/minute of flow
        - its a boost pump
            - like a hydraulically-driven hydraulic pump using the higher rate of flow from EDP 1 to help boost system 2
            - flow from one place to increase power somewhere else
            - airplane is using EDP1 and transferring that power through the PTU to SYS 2 to increase the rate of flow in SYS 2 to make the landing gear come up and down faster
    - what does the PTU need to operate?
        - only matters if ENG 2 fails or EDP 2 fails, then I need the PTU to help raise/lower the landing gear
        - if EDP 2 is running, it doesn't matter – I have all the pressure and flow I need
        - only matters if EDP 2 fails
        - I still need EDP 1 – higher rate of flow in SYS 1 if I'm going to use it to boost SYS 2
    - what are the 3 things the PTU always needs?
        - EDP 2 fail, EDP 1 not failed, and 12% fluid in SYS 2
    - PTU lives in AUTO – while in AUTO, when will the PTU turn ON? (assuming the other 3 conditions are met)
        - 2 conditions
            - on the ground – not at all
            - in flight – if I need to raise/lower the landing gear (assuming the other 3 conditions are met)
                - flaps > 0, PTU will turn on OR
                - landing gear not up and locked

pressurization panel

- 2 cabin pressurization controllers – in both AUTO and LFE control
- they build a pressurization schedule based on 3 primary pieces of information that come from the MCDU
  - departure field elevation
  - cruise altitude (from PERF INIT page 2)
  - landing field elevation (LFE)
    - it uses these 3 altitudes to figure out how and when to pressurize the airplane
    - goal is to keep the **Δ** P within limits, cabin altitude comfortable (no greater than 8,000'), rate of change in cabin altitude comfortable
    - AUTO and LFE controls both manipulate the rate at which air goes out of the system with the outflow valve
    - PACKs push air into the system
    - outflow valve modulates the amount of air out

- if airplane can't get a LFE out of the database (maybe unplanned divert to a non-standard airfield or failure in the database), then I can manually set the landing field elevation by using the LFE control mode
- but if I lose both cabin pressure controllers, now I'm stuck with going to manual
  - manual means I'm taking control of the outflow valve

- positive and negative pressure relief valve
  - positive pressure relief valve (sometimes called the safety valve)
    - protects us from the high end of **Δ** P limits
    - actuates at 8.6 PSI in order to protect me against the **Δ** 8.8 PSI
  - negative pressure relief valve
    - protects us from the negative end of **Δ** P limits
    - protects us from the -0.5 PSI

- up to 37,000' – 7.8 PSI (**Δ** P limitations)
- above 37,000' – 8.4 PSI (**Δ** P limitations)

- DUMP (guarded) button
  - associated with a memory item – smoke evacuation
  - do memory item first, then QRC, then QRH
  - if I press the DUMP button in AUTO or LFE control (in other words, when the airplane controls the outflow valve), 3 things happen:
    - PACKs turn off
    - recirculation fans turn off
    - outflow valve opens commanding a 2,000 fpm rise in cabin altitude up to 12,400'
  - if I am in manual mode – only 2 of these 3 things will happen
    - PACKs turn off
    - recirculation fans turn off
    - I am in charge of the outflow valve in letting the air out (outflow valve is not automatic)

ice protection

- electrical and bleed air driven ice protection
  - electrical – windshield heat and ADS probes
    - windshield heat
      - when AC power is connected to the airplane, both windshields run 120 second tests and then both turn off
      - they stay off until I have 2 sources of AC power on the ground
      - when in flight, if I go down to a single source of AC power – then the left windshield is heated
      - if the left windshield fails, then the right side is heated
    - ADS probes
      - FO side (instrument panel)
      - anytime at least 1 engine is running – all ADS probe heat is on (I can't disable it)
      - protection against non-heated probes – protect against unreliable airspeed or altimeter
      - switch on the FO side allows me to turn an ADS probe heat on before I start an engine – 3 times I will do this
        - 0°C and visible moisture (conditions conducive to icing)
        - contaminated probes
        - any PFD indications or faults related to those systems

  - bleed air driven anti-ice
    - goes to engine cowls and leading edge of wings
    - system stays on until 2 minutes after the ice detectors have no longer detected ice
    - if I lose my ice detectors, have I lost the ability to anti-ice the airplane? – turn mode switch from AUTO to ON

    - takeoff – if I require A/I on takeoff, I will leave the switch in AUTO and set it via my takeoff data
      - am I going to encounter visible moisture prior to 2 minutes after takeoff or 1700' AFE?
      - if its 5°C to 10°C – then I select ENG (takeoff dataset menu – MCDU)
        - when I start an engine, that particular engine's anti-ice valve will open (with engine running, it will be providing bleed air A/I)
      - if below 5°C – then I select ALL (takeoff dataset menu – MCDU)
        - if I select ALL, then the wing A/I valves will open at 40 kts on the takeoff roll

      - why 2 minutes or 1700'?
        - if I encounter those icing conditions prior to 2 minutes or 1700', after that, that's when the AUTO mode takes over – ice detectors detect ice, they turn on and stay on

    - on the ground – taxi or takeoff on contaminated conditions – I will turn on A/I to the takeoff temperature setting in my takeoff dataset menu
      - flip mode switch back to ON
      - back at the gate – flip it back to AUTO

  - test – ENG, WING, OFF
    - 10 minutes after departure or 10,000' (whichever happens first) – A/I wing valve will open
    - this is a normal test of the A/I system
    - it will run until it can increase the temperature of the wings by 10°F (not Celsius) – only Fahrenheit number on the entire airplane or for 60 seconds
    - how do I remember this? 10 – 10 – 10 – 1
      - 10 minutes after departure or 10,000', for either 10°F or 1 minute

air conditioning / pneumatic panel

- 2 PACKs on airplane
- PACKs are automatically turned off during engine start
- when I command that start/stop selector to start, PACKs automatically turn off
- once engine(s) start – PACKs automatically turn back on (assuming the PACK buttons are dark)
- if I press anything on this panel – I'm either commanding the valve closed or the system off
    - in other words:
    - press that RECIRC button – they are commanded OFF rather than operating automatically
    - push the PACKs buttons, I turn the PACKs off
    - XBLEED – press it, I close the crossbleed valve

- air inside vs air outside bleed valve system
- bleed air provided by either APU or engine bleed valves
- I use it for 4 different things:
    - environmental control – both temperature and pressurization
    - water pressurization
    - engine start
    - anti-ice (APU cannot be used as a source for anti-ice)

- 2 places on the engine where I can tap bleed air off from
    - 6^{th} stage – LP bleed
    - 10^{th} stage – HP bleed
    - during a XBLEED engine start – looking for 40~45 PSI
    - I want to make sure I'm on the HP bleed – 10^{th} stage, rather than the 6^{th}
    - for engine start, I want to make sure I've got the higher pressure

- single PACK altitude limitation – 31,000'

- ECS ON vs OFF
    - what does that mean in my takeoff data?
    - what's pressurizing the airplane?
    - if I select I've got ECS ON – that means I've got sufficient thrust available to allow the engine bleeds to pressurize the airplane on takeoff (airplane pressurizes off of the engine bleeds)
    - if I select ECS OFF – this means APU ON – I'm using the APU as my source of bleed air for the pressurization system
    - when I do this, the APU will run everything until 500', airplane will automatically close the APU bleed valve (assuming the airplane panels are dark), open up the engine bleed valves, and switch things over
    - what if I needed ECS OFF but my APU was deferred? – I would still select ECS OFF and I would takeoff. technically, I would be unpressurized for the first 500' but then again at 500' those engine bleeds are going to open and pressurize the airplane – all automatic

passenger oxygen

- AUTO – will make sure the masks drop automatically
- when will they drop automatically? between 14,000' and 14,750' of cabin altitude
- OVRD – I can manually drop the oxygen masks if the cabin altitude ever reaches between 14,000' and 14,750'
- once masks drop, there are 3 masks per side (6 per row) – leaves enough for an extra lap child
- once the PAX actually pulls the masks down, that's when it starts the chemical reaction to generate oxygen – this will provide about 12 minutes of oxygen (12 minutes to give us enough time to get to a lower altitude)
- seatbelts and no smoking signs will automatically turn on
- OFF – no masks
- OVRD – masks right now – MASK DEPLOYED light will turn on (this means masks have dropped in the back)

- crew oxygen
  - green – sufficient for 3 flight crewmembers
  - cyan – sufficient for 2 flight crewmembers
  - amber – numbers or dashes means the system needs to be serviced
  - what does sufficient oxygen for either 2 or 3 crewmembers mean?
    - 22 minutes on 100% oxygen – enough to allow me to make a descent from 41,000' down to 10,000' with the anticipation I can switch to normal and spend a further 98 minutes before I run out of oxygen (basically 2 hours of O2)

nosewheel steering

- SYS 2
- activate it by pushing down on the tiller – feet are commanding the rudder and the nosewheel

- pushback
  - does the crew downstairs see a green light on the nosewheel?
  - in order to have a green light – 3 things need to happen:
    - brakes OFF (emergency and toe brakes)
    - steering OFF (EICAS) – lets us know we've disengaged nosewheel steering
    - ground steering disengage switch needs to be in the disengage position
      - ground steering disengage switch (little red guarded switch near the AC power door)

TIME – 0 to 2:01:58 (finished with overhead panel)

glareshield panel

- lights
- PTT (also on the yoke) – on the panel is the primary one we use
- display reversion – reversionary panel
  - what is the most common failure for you to use that switch?
  - failure of EICAS – airplane wants you to have access to the PFD and EICAS (doesn't care about MFD)
  - decide who is PF – then select MFD

- ADS and IRS sensor switches
  - typically dark
  - automatically revert ADS and IRS systems
  - ADS 1 – left side
  - ADS 2 – right side
  - ADS 3 – dedicated backup
    - ADS combination of probes on the front of the airplane
  - ADS 4 – IESS
  - ADS 5 – sometimes not really called an Air Data System – its a pipeline relaying that air data from the probes to FCMs so our FBW computers get that information

  - switches allow me (if the airplane did not automatically revert to the proper ADS during a failure) – I run the QRH procedure for it and tells me to push that sensor/switch to revert – can push it multiple times cycling through ADS

  - IRS
    - only have 2

- master and caution warnings
  - can one of these switches be deferred? yes but only one so long as the other side (CP or FO side) is working

    - WARNING – immediate pilot action required
    - CAUTION – immediate pilot attention and action is likely required
    - ADVISORY – crew attention; action may be required in the future
    - STATUS – information about the airplane
- can automatically inhibit nuisance messages
- can scroll through EICAS messages, but not warning messages

guidance panel

- DCU – display control unit
  - BARO SET is my altimeter – can toggle between inches and hectopascals (hecto – not required)
  - pushing the altimeter puts it into standard mode – it is different from 29.92
    - airplane considers 29.92 to be a local setting and standard to be a cruise standard setting
    - converts your altimeter to flight levels rather than 1000s of feet
  - HSI
    - PFD
      - top part of PFD is called EADI – electronic attitude director indicator
      - bottom part of PFD is called EHSI – electronic horizontal situation indicator
        - toggles the mode of the HSI
          - toggles between the full compass, arc mode, or arc mode with moving map
          - typically we leave it on the full compass mode because our map page already gives us an arc page with a moving map
  - BRG
    - can pull up additional bearing pointers as necessary
  - WX – don't really use this – we toggle our weather radar from the PFD
  - PREV (preview)
    - brings up preview needles manually
    - these will automatically populate 150 miles from destination
    - will autotune the proper frequency and the course
  - FPR (flight path reference)
    - if you want to see what your current flight path was, rather than just reading it off of your flight path angle indicator – pressing this button will display the airplane's current flight path angle at the time you press the button
  - FMS (flight management system)
    - switches your navigation source to FMS (switches from one side to the other)
    - 3 colors of needles on PFD
      - magenta – indicating FMS
      - green – NAV radio
      - amber – we are both looking at the same source
  - V/L (don't really press this anymore)
    - green needle button
    - if you needed to switch from magenta to green, the V/L button will do that for you
    - if you needed to manually switch from green back to magenta, press the FMS button
  - MINIMUMS (knob)
    - only approach we use radar minimums for is CAT II
    - everything else is a BARO MINIMUM
    - every approach flown with vertical guidance is flown to DA
    - if its a published DA like on an ILS, RNAV approach to LNAV/VNAV minimums, or an RNP approach – all have published DAs
    - can set the decision altitude with this knob
    - if I'm flying the approach to a published MDA, look for a ballnote on the approach plate
      - example – authorized operators may use VNAV DA in lieu of MDA
      - if I see this note, just erase the M – that MDA is now a DA
      - if I don't have that ball note, then I have to add 50' (used to be called a DMDA (derived MDA)

- FD (flight director)
  - clears the flight director if currently presented
- CRS knob
  - rarely use
  - typically the course will autotune 150 NM from destination (flying an approach that requires preview needles)
- NAV
  - tells the airplane to capture the current source of navigation guidance

    - if navigation source is FMS and I push NAV, I will get LNAV
- HDG
    - puts airplane in heading mode
    - airplane will fly to where the heading bug is
- ROLL
    - default mode – keep doing what you were doing
    - all assuming the AP is on
    - 6° or less bank – plane will level the wings
    - 6° - 35° bank – plane will maintain angle of bank
    - > 35° bank – will maintain 35° until I select a different mode
- BANK
    - turn on/off bank limiting mode
    - limits bank to 15°
    - only matters in heading mode
    - anytime in LNAV, airplane won't use more than 35° of bank
    - on PFD – green dot
        - what is green dot?
            - 1.3G above shaker and 40° of bank protection
            - why 1.3? what's my load factor in a 40° bank? 1.3G
            - single engine drift down speed
            - use green dot as a speed for flap extension to return to the field and I don't have time to program or do anything – I'm looking for a safe and efficient speed to extend flaps – I can fly green dot on approach
            - for flap retraction, if my F-bug goes away, then I use green dot + 10
            - why +10 for retraction,when I can extend at green dot?
                - as I remove lift, and I speed up, I expect green dot to go up with me
                - I want to always be above green dot
- APP
    - 2 mode switch – commands both a lateral and vertical mode
    - lateral
        - either LNAV or LOC depending on type of approach loaded
    - what is special about this button? what is special about GS (glideslope) and GP (glidepath)?
        - only vertical modes that don't obey your altitude selector
        - every other mode will stop at whatever is in your altitude selector – only modes that don't – GS and GP – these are approach modes – you have permission to go all the way down to the ground
        - FPA will absolutely respect your altitude selector – only 2 modes that don't – GS and GP
- AP (autopilot)
    - lowest altitude engagement – 400'
    - minimum altitude 50' for ILS
- YD (yaw damper)
    - don't really touch this – YD is an automatic function provided by our FCMs
- SRC
    - switches airplane source from left to right and vice versa
- AT (autothrottle)
    - arms / disarms the autothrottles
- SPEED – FMS and MAN
    - normally we are in FMS speeds (we can be in FMS speeds for the entire flight essentially)
    - if it doesn't know what to do, it will default to whatever you set in PERF INIT page 3 – climb, cruise, descent
    - reason to not fly it? – 250 kts below 10,000' (also departure limit speed – 200 kts up to 2500')
    - FMS speeds make sure you will obey these speeds along the way
    - manual speeds
        - allow me to manually bug an airspeed
        - anytime I have a manual speed selected, the airplane will follow whatever you tell it to do
- VNAV button
    - coolest new button on the airplane but also kinda confuses people the most

- most important thing to know about this button – it's an ON / OFF switch (green to magenta button)
- how do I know that VNAV is on?
  - anytime I have a magenta/vertical mode, VNAV is ON
  - what does VNAV mean?
    - airplane will follow restrictions in the FMS on the way to the altitude selector
    - in other words – if I'm in vertical speed, or FPA, or green FLCH, airplane will stay in that mode all the way up to my altitude selector, where it will capture the altitude and level off

- FLCH (flight level change)
  - maximum performance climb or descent maintaining whatever airspeed you have selected
  - SPDt (speed on thrust)
    - assuming AP/AT is on, will manipulate the thrust anywhere from IDLE to TO/GA in order to make sure I obey the commanded speed
  - SPDe
    - airplane will change its pitch in order to maintain its speed
    - only 3 modes that are SPDe
      - FLCH (green)
      - FLCH (magenta)
      - OVSP
        - everything else is speed on thrust
    - why do I prefer to climb on SPDe?
      - I can't command the airplane into a climb or a descent, but it has insufficient thrust or drag to maintain
      - in other words – I can command the airplane to climb at 5° up or 4000 fpm – thrust levers will go up to TO/GA, but at some point, thrust will become deficient in order to maintain airspeed (limit will start flashing)
  - what about hand flying in FLCH?
    - I decide I won't follow the FD
    - airplane will stay in climb power, but I won't be able to maintain my airspeed (i'll either get fast or slow not following the FD, b/c the FD is telling me what pitch I need to be at to maintain that speed
- ALT (altitude)
  - immediate altitude capture – “oh crap button”
  - capture whatever I'm at right now and stay there
- FPA (flight path angle)
  - commands the actual flight path of the airplane regardless of whatever pitch or vertical speed it will take to do that
  - PFD
    - little green airplane symbol is my current FPA
    - FPA means what is the airplane doing with relation to the horizon?
  - also the default vertical mode
    - its the most accurate representation to the airplane that I will keep doing whatever I was doing
  - 0 FPA = level flight
- VS wheel
  - safety blanket

- know what an RA looks like
  - can I use the TCS (touch control steering) button to respond to an RA? no
  - RAs must be hand flown
  - click off AP/AT and do it myself

- GPWS (ground proximity warning system) – pronounced “Gip Wiz”
  - alert – both visual and audible indication – “TERRAIN TERRAIN” “PULL UP”
  - flag – amber or red on PFD (GDN PROX)
  - proper course of action – max thrust , 20° nose up, until clear of terrain
  - what happens if I get an RA? night time and I'm in the weather. it tells me “descend, descend”
    - I follow the RA descending, but now I get a “TERRAIN TERRAIN” – what do I do? – follow the GWPS over the RA – I would definitely hit the ground, but I might not hit another airplane – GPWS always takes priority to that

PFD

- trend tapes – 10 seconds for airspeed and 6 seconds for altitude
  - white lines indicating on the PFD – it tells me I will reach whatever speed or altitude that is in the 10s/6s time
- next to FPA
  - speed air tape and acceleration pointer (carrot and line)

- WS
  - 2 kinds of WS alerts I can get on the PFD
    - warning or caution
      - warning – decrease in performance shear
      - caution – increase in performance shear
      - required to go-around and follow WS guidance escape maneuver (on a warning)
        - I can make the decision on a caution alert
        - anytime I have a warning, WS guidance will automatically be activated
          - procedure the same – push thrust to MAX, follow FD guidance, no configuration changes until clear of WS and clear of terrain
        - if it's a caution alert and I want to activate the WS guidance escape maneuver
          - press the TO/GA button
          - procedure the same – push thrust to MAX, follow FD guidance, no configuration changes until clear of WS and clear of terrain

- ATTCS (automatic takeoff thrust control system)
  - gives me RSV thrust automatically anytime I have an engine failure, thrust lost, and WS
  - am I already getting RSV thrust if I'm in TO/GA and I run into WS? absolutely
  - I can also manually activate RSV thrust by pushing to MAX
  - what is RSV thrust? the extra 1,200 lbs of thrust over and above whatever setting you're already in
  - TO-1 and go-around = highest thrust setting we have (extra 1,200 lbs of thrust above whatever we already had)

- FLEX thrust
  - only 3 times when I can't use FLEX
    - WS
    - contaminated RWY
    - if prohibited by the procedure
      - what does prohibited mean? either I have a complex special the specifies NO FLEX or I have a procedure or note that says reduced thrust takeoffs not allowed
- FMAs on takeoff
  - lined up on runway and ready for takeoff – I will see:
    - ROLL and TO in my lateral and vertical modes
    - LNAV and VNAV displayed in my armed lateral and vertical modes
    - RWY heading checked – CP arms the AT – I'll see a white TO
    - advance thrust for takeoff – stabilize at 40% – advance more – AT take the rest
    - 50° TLA – AT grab
    - then set TO thrust
      - PF “check thrust”
      - PM looks at EICAS for 3 things:
        - ATTCS must turn green (indicating its able to provide RSV thrust)
        - needle must be in the carrot (chevron) for N1
        - rest of engine instruments in the green
      - PM – “thrust checked”
    - white TO turns into a green TO
    - 60 kts on takeoff roll – 2 things happen
      - TO turns to HOLD
        - what does HOLD mean?
          - AT servos have disconnected – means the only thing that can move those thrust levers is you even

though the AT are still on (to reject a TO)
        - TAS, TAT, SAT – all become valid
    - 80 kts – "checked"
        - 2 things – check airspeed and check for pilot incapacitation
    - 100 kts
        - ROLL turns to TRACK
            - TRACK – only lateral mode
    - VNAV jumps up and replaces the active mode – turns into magenta FLCH

- holding speeds
    - 6000' or below – 200 kts
    - above 6000' – 210 kts
        - never less than green dot
            - only time you'll see less than green dot is immediately after takeoff and sometimes on approach

- make sure you can calculate a V_{AP} approach (if given V_{REF} and winds)
    - on the test – you'll have all the pieces – headwind, gust, and V_{REF}
    - $V_{REF\ NEW}$ – set V_{REF} equal to something – we've had a failure (V_{REF} + flaps + 10 – example) – its our new V_{REF}

- speeds
    - V_{REF}
        - reference landing speed – I intend to cross the threshold 50' above (landing data is predicated upon)
    - V_{AP}
        - what I'm actually going to fly
        - it is V_{REF} corrected for winds
    - V_{AC}
        - approach climb
        - its like a V2 but for go-arounds
        - speed I'm going to fly on a go-around if I lose and engine
    - V_{FS}
        - final segment climb speed
        - minimum speed I'll accelerate to in the climb once the gear has cleaned up / slats/flaps up

- primary source of navigation
    - FMS
    - why FMS and not GPS?
        - I'm using a combination of GPS data, IRS data, and VOR/DME

- NAV radios
    - normally set to autotune
    - how do I know that?
        - magenta is autotuning in active frequency
        - if green, it's not autotuning

- PTH (path mode)
    - way we normally descend – profile
    - like a magenta version of FPA
    - airplane says I have a defined point in space here and another defined point in space here and it will draw a line in between the two of those
        - automatically entered into the airplane assuming 3 conditions are met
            - LNVA, VNAV, lower altitude
    - David really goes into depth here – I'm lost
    - practical application of all of this will happen in PT

MFD

- can I refuel this airplane with PAX onboard? – yes
- can I refuel this airplane with the MCD closed? – yes
  - exits can't be obstructed
- can I refuel this airplane with the jetbridge connected and MCD open? – yes
- can I refuel with an engine running? – yes
  - but no PAX onboard (crew only)

- single engine turns – ?

- cockpit poster – can bring to class on test day
  - systems – status
  - systems – fuel
  - systems – hydraulics
  - systems – ECS
  - systems – flight controls
  - systems – electrics

- flight control check – do we need to see a green box? – we need to see all the surfaces moving and deflecting in the correct direction (looking for white dashed lines)

EICAS

- what happens if I have a message with a carrot/chevron next to it?
  - root message – solving that message will solve the majority of other problems listed – going to solve other messages for me (its a big flag that says do this first)
- what happens if I have a bunch of root failures or a lot of messages?
  - do warnings first
  - then look for any root messages
  - then prioritize the electrical buses
  - MAU (modular avionics unit)

- different thrust modes
  - acceptable range for N1 on takeoff data?
    - -0.1 / + 0.5
  - TO-1
  - TO-2
  - CON (closest thing to MCT setting – maximum thrust airplane can continue to do)
    - typically only use this in our single engine profile
  - CLB 1 (non derated climb thrust)
  - CLB 2 (derated climb thrust)
  - CRZ thrust
    - what triggers it to go from CLB to CRZ thrust? – I've leveled off at the altitude selected and I've maintained my bugged airspeed for 90 seconds
  - GA (go-around)
    - what triggers the airplane to change into GA?
    - people get confused with the hydraulic system
      - hydraulics are flaps only
      - GA is landing gear and flaps

- autobrakes
  - 4 settings – RTO, OFF, LO, MED, HI
    - RTO (rejected takeoff)

            - is there a difference between maximum manual braking and RTO? – no (they are the same)
            - can only be set on the ground (not for flight)
        - in flight – you can select LO, MED, HI (these are rates of deceleration)
            - is HI autobrakes the same as maximum m annual braking? no
            - MED is roughly twice the stopping performance of LO
            - HI is roughly twice the stopping performance of MED
            - no thrust reverse and autobrakes MED / thrust reverse and and autobrakes MED – have I decreased my landing distance at all? – no because the airplane is still going to decelerate at the same rate – only difference is that if I use thrust reversers, then I'm using less braking to achieve that same rate of deceleration
            - if on a contaminated runway – use MED and thrust reversers
            - fastest way to stop the airplane – maximum manual braking + thrust reverse (stand on those brake pedals)

- 4 braking protection features
    - automatic wheel braking
        - during main gear retraction
            - applies the brakes to make the wheels stop in the wheel well
            - nose gear – wheels stopped by a mechanical device in the well
    - touchdown protection
        - stops the brakes from being applied on touchdown until after 3 seconds WOW or until wheels themselves have accelerated up to 50 kts – that's wheel speed, not airspeed (won't allow the brakes to be engaged) – protection against blowing a tire or directional control issue
    - locked wheel protection
        - compares wheel speeds across the left and right side
        - anytime there's a greater than 33% difference between wheel speeds, then it will cut out braking to the slow side allowing it to accelerate back up and then apply the brakes again
        - why 33%? – to allow a difference for differential braking to steer
        - cuts out at 30 kts – why 30 kts? – at slower speed, I still want to be able to steer with 33% differential braking
    - anti-skid protection
        - modulates brake pressure to maintain the best traction
        - stops wheels from skidding
        - dramatically decreases our stopping distance + improves braking performance
        - disengages below 10 kts – can intentionally lock a wheel and pivot on it to make a tight turn

    - do I get any of these braking features when I actuate the parking brake? – no
        - icy runway, Jackson Hole in December – feet on the brakes, anti-skids starts working – if you pull the parking brake, you lose the anti-skid protection

IESS (integrated electronic standby system)

- ADS 4 drives the IESS
- set by the CP (altimeter)
- takes 90 seconds to align (airplane can't be moved)
- can fly an ILS on here (raw data and won't be fun, but we can do it)
- can't fly BC approaches – OpSpec pulled for this and not a single tear was shed

instrument panel – ground proximity terrain inhibit

- inhibit for the GPWS that would turn off the terrain indications
- typically only do this if directed by the company pages

instrument panel – emergency parking brake

- if it is ON and parking brake set – you have sufficient pressure to brake or hold the airplane in place

know engine start and APU limitations

landing gear

- downlock release button
  - there is a lock in the gear handle itself – if airplane has a WOW indication – it won't allow you to put that gear handle up
  - if we have a faulty WOW indication after takeoff and you can't put the gear up
    - normally – leave the gear down, come back around and land
    - but – what if we had terrain ahead of us? need to get rid of drag – need climbing performance – press the downlock release button – it commands the gear up

- 3 ways to actuate the landing gear
  - gear handle (instrument panel)
    - actuate the gear handle – electric signal to PSEM (proximity sensor electronic module) – talks to the landing gear and then begins the actuation process
    - releases the uplocks and brings the gear down
    - pulls gear up – primary means of keeping it up – uplocks
  - electrical override switch
    - red switch – FO side floor
      - move to gear down – bypasses the PSEM
  - alternate gear extension handle
    - freefall extension of the landing gear
    - I manually release the uplocks and any residual hydraulic pressure in those lines
    - nothing else holding it up

ELT

- lives in ARM

GND PROX G/S INHIB

- inhibits glideslope related warnings of GWPS (under the direction of the QRH)

water dump button – FO side

- press during descent of LFOD
- commands the potable water tank to drain via the 2 heated drain masks on the bottom of the airplane
- 4 things make the light in that switch go out
  - if tank is empty
  - if I push it again – I've started the process; I've stopped the process
  - lower the landing gear (don't want water splashing onto the landing gear – even though heated, it could freeze)
  - if there is a drain mask heater fault
    - only indication of this – AFT FA control panel
    - make a note of it – talk to FA about it

MCDU

- RADIO page
  - what does ACARS use to communicate? COM 3 (my data radio)
    - if I don't have COM 3, then ACARS would be deferred
  - COM 1 and 2 for talking – COM 3 for data
  - how do I access ACARS? – DLK (datalink) button

Flight Control Mode switches (center pedestal)

- elevators, rudders, spoilers
- puts into direct mode – cuts FCM out of the loop
- be familiar with higher level functions and give a basic description

stall warning – shaker 1 / shaker 2 cutout

- disables the stick shaker channel
- AP disengages when shaker goes off
- AT will not (have to manually disengage the AT)

engines

- be familiar with engine start limitations and engine start duty cycles
- 3 types of abnormal engine starts (FADEC will automatically abort for)
    - hot start
    - hung start
    - no light off
        - these are reasons I would also manually abort the engine / ignition start
        - regardless if FADEC or I do it – I still have to do the memory item – why? because, if FADEC aborts the start, FADEC will get rid of the fuel, but I have to close the starter control valve
            - starter control valve – bleed air valve allowing N2 to turn

- dry motoring – be familiar with these limitations
    - one of those times you will take the ignition switch out of AUTO under the direction of the QRH for a dry motor
    - AUTO to OFF – I'm commanding 2 things:
        - turn ignition OFF
        - telling FADEC not to introduce fuel as I dry motor

- you won't get a message for an abnormal start on the EICAS
    - its a non-annunciated procedure

- only time you will get a message related to engine start – exceedance (you have exceeded a limit)
    - call MX

CCD (control cursor device)

- it is a way to tune the radios

T/O CONFIG

- checks for 4 things – flaps, spoilers, brakes, trim
- does the flap lever setting match what we put into the MCDU? otherwise? no takeoff flaps
- are any spoilers deployed? otherwise no takeoff spoilers
- is the parking brake set? no takeoff brakes
- is the pitch trim in the green range? if not, no takeoff trim

EICAS FULL

- show me the FULL EICAS
- un-declutter for EICAS
- 30 seconds after landing gear up and flaps up and APU off, EICAS will automatically declutter the expanded engine information – gear, flap indications, and APU

speedbrake lever

- commands actuation of the multi-function spoiler panels – 3 OB panels on each wing
- these will function as our speedbrakes
- 3 conditions when the speedbrakes will automatically retract
  - flaps > 1
  - < 180 kts airspeed
  - 70° TLA
    - where is 70°? – just shy of TO/GA

thrust levers

- A/T disengage – big button where TO/GA used to be – button on the side
- what else disengages the A/T? – pushing to MAX or splitting the thrust lever heads by 8° (8° = half of a knob ?)
- 2 minutes warmup before advancing thrust levers for takeoff
- 2 minute cooldown before shutting down an engine
- 40~45 PSI for XBLEED start

thrust reversers

- start reducing towards MIN REV at 80 kts
- be there by 60 kts
- be in forward by 30 kts

- can use thrust reverse the whole time until the airplane comes to a complete stop (in shortest distance possible)

RAT

- manual deploy
- trigger the QRH will direct us to pull this:
  - electrical emergency
  - BATT discharging

CAB, RAMP, EMER (audio panel)

ID (filters out the voice) – all I want to do is listen the NAVAID

ground proximity flap override

- inhibits flap warnings of GWPS under the direction of the QRH if landing with a non-standard flap setting

trim panel

- all 3 have a 3 second automatic cutaway – to help prevent runaway
- only one that will yell at you – pitch trim
- trim priority – backup switch, CP yoke, FO yoke, FCM (not AP)

door lock

- unlock and lock door
- if somebody knows where the button is outside to try to get it – they press it – I have 30 seconds to decide to press the inhibit button if I don't want to let them in – will inhibit for 500 seconds (less than 7.5 minutes) – if they try again, we just inhibit them again

slat / flap lever

- takeoff settings
    - 1,2, and 4
- landing settings
    - 5 and FULL
- go-around setting for flaps 5
    - flaps 2
- go-around setting for flaps FULL
    - flaps 4

- can I ever fly a FULL flap CAT II?
    - no – flaps 5 only

PA (public address button)

- talk directly to the passengers
- as soon as you let go, your radios go back to normal

cockpit printer

aileron / elevator disconnect

- disconnect the 2 control columns
- then I command the airplane with the unjammed side and unjammed control surface
    - I pull the aileron disconnect
        - I determine that the right side is jammed and the left side is OK
        - I will be flying the airplane from the left side
        - I will be commanding roll by using the left aileron, not the right

yoke

- PTT
- center – interphone (OFF button – interphone cutout)
- TCS – touch control steering
    - AP pause button – while holding this button, the FPA is synced up
- steering disengage – trigger on the backside of the yoke

CB

- physical (thermal) CB in flight deck
- electric – access on MCDU